NEW MAGNETIC CHARTS OF THE INDIAN OCEAN.

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(*Read April 20, 1912.*)

The charts exhibited embody the results of magnetic observations made during the summer and fall of 1911 on board the non-magnetic yacht *Carnegie* operating under my direction as Director of the Department of Terrestrial Magnetism of the Carnegie Institution of Washington.

The necessity of the new charts arose from the exceptionally large errors found in the most recent magnetic charts at present in use by mariners. Thus, for example, the errors in the compass directions for two of the most recent charts approximate respectively four degrees and six degrees, though one of them was issued as recently as 1910. With the exception of a few values found by the vessel, the *Galilee,* used in the Pacific Ocean work, these are the largest errors thus far revealed. In the portions of the Atlantic Ocean thus far covered by the *Carnegie* the compass chart errors have generally been below two degrees, though running at times up to two and a half degrees.

The chart errors in the compass directions are usually found to be systematic, that is, in the same direction for large stretches, and are to be ascribed largely to erroneous secular changes allowed for in attempting to bring previously observed values up to date.

Thus, for example, by comparing the *Carnegie* values of 1911 with those obtained on board the German Antarctic vessel, the *Gauss,* in 1903, it is found that the north end of the compass moved to the eastward (hence diminished west declination) at the average rate of about 11′ per year off the southeast end of Africa, whereas in the vicinity of the islands of St. Paul and New Amsterdam in the Indian Ocean (lat. 35° 16′ S., long. 74° 46′ E.) it moved to the westward (increased west declination) at the average rate of about

13′ per year. The charts give secular changes of only about one fourth of these amounts, so that the error of reduction in but ten years amounts to almost 2°. It is doubtless due to these large secular changes disclosed in the Indian Ocean, and especially their rapid variation with geographic position, that the large errors mentioned have crept into the charts.

The errors in the other magnetic elements, while of less importance to the mariner, are of consequence to theoretical investigations regarding the earth's magnetism. In the magnetic dip, the errors on the present cruise have amounted at times to 4°, and in the horizontal intensity to about one-twentieth part. While some of the results derived from previous analyses of the earth's magnetic field have pointed to the possibility of large and more or less systematic chart errors, it was not suspected that they would reach the magnitude disclosed by the work of the *Galilee* and of the *Carnegie*.

The *Carnegie* is at present making a circumnavigation cruise and is expected back in New York towards the end of 1913, having left the same port in June, 1910. Up to February 1, 1912, this vessel had already covered about fifty thousand miles. She left Manila on March 23, in command of Mr. W. J. Peters, bound for the Fiji Islands.

Owing to the non-magnetic structure of the *Carnegie* and the absence in consequence of any deviation corrections, it is possible to obtain and communicate results expeditiously. The data are promptly transmitted to the chief hydrographic establishments issuing magnetic charts in order to enable them to make the necessary corrections from time to time.